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Published in:
Health Policy OPEN

DOI:
[10.1016/j.hpopen.2019.100002](https://doi.org/10.1016/j.hpopen.2019.100002)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2020

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Woerdenbag, H., & Hak, E. (2020). Interview-based cross-sectional needs assessment to advance the implementation of an effective antibiotic stewardship program in Indonesian hospitals. *Health Policy OPEN*, 1, [100002]. <https://doi.org/10.1016/j.hpopen.2019.100002>

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Interview-based cross-sectional needs assessment to advance the implementation of an effective antibiotic stewardship program in Indonesian hospitals

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ARTICLE INFO

Article history:

Received 24 July 2019

Accepted 1 December 2019

Available online 07 January 2020

Keywords:

Antibiotic stewardship

Structural indicators

Needs assessment

Hospital

Indonesia

ABSTRACT

Antibiotic resistance has become a global health issue, negatively affecting the quality and safety of patient care, and increasing medical expenses, notably in Indonesia. Antibiotic stewardship programs (ASPs) aim to reduce resistance rates and their implementation in hospitals, has a high priority worldwide.

We aimed to monitor the progress in the organizational implementation of ASPs in Indonesian hospitals by an Antimicrobial Resistance Control Program (ARCP) team and to identify possible hurdles. We conducted a cross-sectional study with structured interviews based on a checklist designed to assess the achievement of structural indicators at the organizational level in four private and three public hospitals in four regions (Surabaya, Sidoarjo, Mojokerto, Bangil) in East Java, Indonesia.

The organizational structure of public hospitals scored better than that of private hospitals. Only three of the seven hospitals had an ARCP team. The most important deficiency of support appeared to be insufficient funding allocation for information technology development and lacking availability and/or adherence to antibiotic use guidelines. The studied hospitals are, in principle, prepared to adequately implement ASPs, but with various degrees of eagerness. The hospital managements have to construct a strategic plan and to set clear priorities to overcome the shortcomings.

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Key messages

There is an obvious need for sufficient resources for information technology development, for dissemination of guidelines for antibiotic use, and for provision of information about the use of appropriate antibiotics to educate patients.

1. Introduction

Any use of antibiotics will contribute to antibiotic resistance, including the appropriate use of antibiotics. Antibiotic resistance is caused by the mutation of pathogenic micro-organisms, following inappropriate and superfluous use of antibiotics [1,2]. An antibiotic resistance study by the Indonesia Agency for Health Research and Development, Indonesian Ministry of Health (*Badan Litbang Kesehatan Indonesia* 2013) reported during a seminar in 2014, revealed that in six public hospitals in Indonesia the prevalence of extended-spectrum β -lactamase in isolates of *E. coli* was 45%, in isolates of *K. pneumoniae* 42%, and in isolates of *K. oxytoca* 26% [3].

Antibiotic resistance is a serious worldwide health problem that jeopardizes the quality and safety of patient care and may substantially increase treatment costs. For these reasons the World Health Organization (WHO)

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and the Center for Disease Control and Prevention (CDC) emphasize the necessity for every hospital worldwide to implement an antibiotic stewardship program in order to prevent the development of antibiotic resistance [1,3]. The implementation of antibiotic stewardship programs in Indonesia is achieved by the establishment of an Antimicrobial Resistance Control Program (ARCP) team in all hospitals as stipulated in the Ministry of Health Regulation of the Republic of Indonesia No. 8 Year 2015 [4]. The ARCP is a new important standard for hospital accreditation in this country (*Standar Nasional Akreditasi Rumah Sakit*, SNARS) published in 2017 [5,6]. Therefore, in 2018 an assessment of the ARCPs was conducted by a hospital accreditation committee in every hospital in Indonesia for the purpose of hospital accreditation [5]. The ongoing high rates of antibiotic resistance in Indonesia, however indicate that the implementation of ARPs in most hospitals has not adequately been achieved, possibly due to a lack of facilities, infrastructure and strategies such as audits and feedback [7].

Strategies and priorities to provide resources to overcome the problems with implementation of antibiotic stewardship are based on a hospital's individual policy. Several studies reported that the needed resources required not only include audits and feedback by antibiotic stewardship teams but also comprise the purchase of information technology and software as well as the set-up of a microbiology laboratory [8]. There is a study in a single large tertiary care teaching medical center, where a stewardship program was considered part of the infection control program and no additional resources were required [9].

1.1. The aim of the study

To make a complete ARCP needs assessment, we aimed to assess the fulfillment of four domains (organization structure, leader support, internal and external factors, and information availability) necessary for the organizational implementation of antibiotic stewardship programs in selected private and public hospitals in Indonesia.

2. Materials and methods

We conducted a cross-sectional study with structured interviews in which observations were made using a questionnaire (Appendix 1) designed to assess the achievement of structural indicators at the organizational level of hospitals. In Table 1 demographic details of the seven hospitals included in this study are listed. The hospitals were selected based on their nature (public versus private), variety in number of beds, different levels of care provided and location (East Java, Indonesia).

Hospital classification in Indonesia is done according to the Ministry of Health regulations [10]. There are three levels of care in the Indonesian health system. The primary care is a health facility providing a patient's first access to the health care. If specialized care is needed, the patient can be referred promptly to secondary (a secondary hospital) or tertiary

care (a tertiary hospital) [11,12]. The Indonesian health system has a mixture of public and private providers and financing [13,14].

The questionnaire was based on CDC Core Elements of Hospital Antibiotic Stewardship Programs [15], Structural Indicators for Evaluating Antimicrobial Stewardship Programs in European Hospitals [16], the Belgian Antibiotic Policy Coordination Committee (BAPCOC) (used in Belgium, Europe and America for auditing the quality of antibiotic stewardship programs) [17], and National Standards for Hospital Accreditation in Indonesia [5,6]. The respondent (one for each hospital) was the person in charge of the hospital management who was responsible for the medical service to the patients. The interviews were performed by the authors. To ensure validity of interview result per respondent, the interview results were compared to document observation results by the authors, including circular letters of director, operational standards manuals, antibiotic usage manuals, formularies, hospital antibiogram, and antibiotic resistance prevalence reports available in the hospital. We attributed score 2 (Table 2, Internal and External Factors of the Hospital) in case a document was available support the interview. The results were presented to and discussed with the hospital staff. What we found was fully acknowledged and already recognized by them.

In the questionnaire four domains were distinguished: organizational structure, leader support, internal and external factors of the hospital, and information availability (Appendix 1), each with a number of questions (items), that were answered by the interviewed staff. These domains were based on the sources [5,6,15–17] used to compile the questionnaire. In the analysis, the scores per item within a domain and overall were summed (Table 2). The total score per hospital was divided by the maximum score of 40 points and multiplied by 10. We subdivided a scale of 0–3 as “low” ARCP implementation; scale 4–6 as “intermediate” ARCP implementation; scale 7–10 as “high” ARCP implementation.

3. Results

Not all hospitals under study had an ARCP team. Only one hospital allocated funds for information technology (IT) development. All hospitals had a policy for the medical doctors with respect to antibiotic use. Nearly all hospitals had an antibiogram. The antibiotic stewardship implementation scores between hospitals varied, from low (hospitals A and B), to intermediate (hospitals C, D, and E), and high (hospitals F and G) (see Table 2). Of the three public (government financed) hospitals, two had an ARCP team installed. Two hospitals were in the readiness stage from an organizational perspective (score 9 out of 10), three hospitals were in the intermediate readiness stage (4.5/10, 4.5/10, 5.5/10 respectively), and two hospitals was in the early readiness stage (1/10, 2/10) of implementing the antibiotic stewardship program (see Table 2). The data from the seven participating private and public hospitals show that the stage of developing ARCP varied. One hospital (hospital A) was not ready to implement the antibiotic stewardship program; it merely had a policy for the doctors to prescribed antibiotic and the antibiogram.

Table 1
Hospital demography.

Characteristics	A	B	C	D	E	F	G
Hospital classification ^a	B	B	B	C	A	B	C
Levels of care	A tertiary hospital	A tertiary hospital	A tertiary hospital	A secondary hospital	A tertiary hospital	A tertiary hospital	A secondary hospital
Number of bed	117	172	235	225	467	134	109
Area geographical	Surabaya municipality	Mojokerto regency	Surabaya municipality	Sidoarjo regency	Sidoarjo regency	Surabaya municipality	Bangil district
Ownership	Private	Government (public)	Private	Private	Government (public)	Private	Government (public)

^a According to Ministry of Health Republic of Indonesia (MoH-RI). [Peraturan Menteri Kesehatan No. 56 tahun 2014: Klasifikasi dan perizinan rumah sakit]: MoH-RI; 2014.

Table 2
The hospitals readiness in the implementation of antibiotic stewardship.

No.	Components	Max score	A	B	C	D	E	F	G	Total (%)
	Organizational structure									
1.	Availability of ARCP team	2	0	0	0	0	2	2	2	6 (43)
	Multidisciplinary communication	2	0	2	0	2	2	0	2	8 (57)
	Multidisciplinary in ARCP	2	0	0	0	0	2	2	2	6 (43)
	Doctor as ARCP leader	2	0	0	0	0	2	2	2	6 (43)
	Presence of clinical pharmacist	2	0	2	0	2	2	2	2	10 (71)
	Total	10	0	4	0	4	10	8	10	
	Leader support									
2.	Formal statement of ARCP team establishment	2	0	0	2	0	2	2	2	8 (57)
	Fund allocation for ARCP	2	0	0	2	0	0	2	2	6 (43)
	Fund allocation for health personnel education	2	0	0	2	0	2	2	2	8 (57)
	Fund allocation for IT development	2	0	0	2	0	0	0	0	2 (14)
	Provision of education	2	0	0	2	2	2	2	2	10 (71)
	Total	10	0	0	10	2	6	8	8	
	Internal and external factors of the hospital									
3.	Availability of policy for the doctor to administer doses, amounts, and direction of antibiotic use in hospital	2	2	2	2	2	2	2	2	14 (100)
	Availability of antibiotic use guidelines (Pedoman Penggunaan Antibiotik, PPAB)	2	0	0	0	0	0	2	2	4 (29)
	Availability of operational standards for audit and feedback by pharmacy	2	0	0	0	2	0	2	2	6 (43)
	Policy of antibiotic use	2	0	0	0	2	2	2	0	6 (43)
	Access of guidelines/journal	2	0	0	2	2	0	2	2	8 (57)
	Total	10	2	2	4	8	4	10	8	
	Information availability									
4.	Availability of data on the level of antibiotic use (DDD/100 bed-days)	2	0	2	0	0	0	2	2	6 (43)
	Socialization of the prevalence of resistant bacteria to prescriber	2	0	0	2	0	0	2	2	6 (43)
	Distribution of antibiograms throughout the wards	2	2	0	2	2	0	2	2	10 (71)
	Distribution of formularies to the entire wards	2	0	0	0	0	2	2	2	6 (43)
	Information on the wise use of antibiotics for patients	2	0	0	0	2	0	2	2	6 (43)
	Total	10	2	2	4	4	2	10	10	
	Total		4	8	18	18	22	36	36	
	Scale organization level: total/40 × 10		1	2	4.5	4.5	5.5	9	9	

Among the four domains, from lowest score to the highest score, leader support and information availability had the lowest average score (6.8), the subsequent domains were organization structure (7.2), internal and external factors (7.6).

Descriptive analysis of all potential barriers revealed that in all participating hospitals fund allocation for IT development and availability of guidelines for antibiotic use were not well developed or even absent.

Organizational aspects that were well developed in all hospitals included the presence of a hospital pharmacist as part of the ARCP team, the provision of educational information from the management, the availability of information for doctors on the appropriate type and dosing and administration of antibiotics, and the distribution of antibiogram throughout the wards.

4. Discussion

Similar to other developing countries, addressing antibiotic resistance in Indonesia requires a systems perspective. For the successful implementation of a sustainable and comprehensive antibiotic stewardship program in hospitals, leadership, commitment, and sufficient funding are needed [18–21]. The results of the Organization Structure domain show that less than 50% of the hospitals have an ARCP team. ARCP serves to control the use of antibiotics to reduce the incidence of antibiotic resistance.

The relevance of an ARCP is supported by a systematic review of 32 studies by Baur et al. showing that the implementation of antibiotic stewardship programs for at home illness in 19 countries could significantly reduce 51% of incidence of infection, 48% of extended-spectrum β -lactamase-producing Gram-negative bacteria, 37% of methicillin-resistant *Staphylococcus aureus*, and 32% the incidence of *Clostridium difficile* infections [22]. Based on this research evidence it was recommended that every hospital should immediately start the implementation of formation of an ARCP. Not only the availability of ARCP team but also multidisciplinary communication among professionals is a critical point to the success of the ASP implementation [23].

From the scores of the Leader Support domain, it appears that less than 50% of the hospitals had fund allocation for ARCP and that only 14% of the hospitals had fund allocation for IT development. In 1999 The Belgian Antibiotic Policy Coordination Committee (BAPCOC) created a situation in which all acute care hospitals in the country received financial and technical support for hiring a trained manager for their antimicrobial management teams. This intervention, the antimicrobial management teams and the antimicrobial management teams funding, improved the antimicrobial use for patients admitted to hospital for pneumonia and lower limb surgery between 1999 and 2010 in Belgium [24]. Based on this information, fund allocation is strongly recommended for needed supports for the ARCP in each hospital.

The study by Van Limburg et al. aimed at analyzing progress and obstacles in the implementation of the antibiotic stewardship program at nine hospitals in the Netherlands (three educational and six non-educational hospitals) [25]. It was shown that only 25% of educational hospitals and 18% non-educational hospitals had implemented IT for antibiotic stewardship programs. According to the CDC, the role of IT in the integration of antibiotic stewardship with the services provided at a hospital is imperative. This role includes giving support for decisions regarding antibiotic prescriptions, providing facilities for the collection and reporting of antibiotic use, as well as providing information and protocols that can be directly linked to ARCP or clinical pathways owned by the hospital, thereby potentially improving the rational use of medicines [9]. This finding is supported by the study by Charani et al. showing that there was an insignificant increase in the adherence to the use of antibiotics on empirical therapy in the treatment of hospitalized patients [26]. The increase was significant, however, in the operating theater. In addition, there was an increased (but insignificant) percentage in documenting a stop/review date regarding the prescription of hospitalized patients. Based on this research evidence, it is necessary to allocate funds for IT development in order to realize the optimum goals of an effective ARCP at each hospital.

Research on the internal and external factors of the hospital showed that the availability of guidelines for antibiotic use was in the low category,

because not all hospitals have guidelines for antibiotic use. The study by Van Limburg et al. showed that 88% of educational hospitals and 73% of non-educational hospitals implement antibiotic formulary for antibiotic stewardship program [25]. Guidelines for Antibiotic Use is a guideline according to the types of infections in patients or as prophylaxis for surgery [27,28]; therefore an ARCP can assist in the selection of antibiotics. According to the IDSA's guideline, the development of Guidelines for Antibiotic Use from recent literature and antibiotic resistance reports is an additional component for implementing antibiotic stewardship. This is supported by a study reporting that the use of Guidelines for Antibiotic Use in intensive care unit (ICU) could reduce approximately 77% of antibiotic use and treatment costs, decrease patient mortality resulting from infections and decrease the length of stay in ICU compared to before using an ARCP as a guide for choosing antibiotic therapy [29]. Based on this information, it is recommended that each hospital immediately starts to prepare guidelines for antibiotic use to be used in the rational and responsible selection of antibiotic therapy.

The results of the research on the information availability domain showed that only 43% hospitals provide information to the patient to use antibiotics wisely. Hospitals provide information on the rational use of antibiotics through leaflets, posters and light-emitting diode (LED) banner displays for both outpatients and inpatients, as there are several out-of-hospital patients who still continue to consume antibiotics in accordance with the duration of administration. Research conducted by Eells et al. in 188 patients with skin infections aimed to determine the adherence to the use of antibiotics during out-of-hospital care [30]. This study showed that patients had poor adherence to antibiotic use after checking out of hospital with worsening clinical outcomes.

Based on Rosenstock's Health Belief Model (HBM) theory, there are several construct determinants for the likelihood behavior (i.e. individual perception), some modifying factors (age, sex, ethnicity, personality, socioeconomic, knowledge), and cues to action. Knowledge is a modifiable factor and the perception of the provision of information to patients is useful for improving their knowledge [31]. Knowledge is one of the factors that influence our beliefs, which in turn affects behavior such as an increase in the adherence to the use of antibiotics as a means to improve the success of therapy and prevent antibiotic resistance. This is in line with a study conducted by Munoz et al. [32], where 126 patients were divided into two groups: 62 patients in the intervention group and 64 patients in the control group. The results showed that there was a significant difference in the level of conformity between the intervention group that was educated and the control group. Based on this information, it is recommended that each hospital provides reliable information regarding the use of antibiotics to patients through leaflets, posters and LED banner displays as an appropriate form of action and a means to increase the rational use of antibiotic.

5. Conclusions

The studied hospitals are, in principle, ready to implement adequate ASPs, but with various degrees of readiness. The main barriers are a lack of fund allocation for IT development (6/7) and unavailability of guidelines for antibiotic use (5/7). Every hospital should immediately start to implement an ARCP according to Indonesian national standards.

Abbreviations

ARCP	Antimicrobial Resistance Control Program
ASPs	Antibiotic stewardship programs
BAPCOC	The Belgian Antibiotic Policy Coordination Committee
CDC	The Center for Disease Control and Prevention
HBM	Health Belief Model

ICU	Intensive care unit
IT	Information technology
LED	Light-emitting diode
Menristekdikti	<i>Menteri Riset, Teknologi dan Pendidikan Tinggi</i> (Ministry of Research, Technology and Higher Education of the Republic of Indonesia)
SNARS	<i>Standar Nasional Akreditasi Rumah Sakit</i> (National Standards for Hospital Accreditation)
WHO	The World Health Organization

Acknowledgements

This study was conducted in the framework of a collaboration agreement between the Faculty of Pharmacy University of Surabaya, Jalan Raya Kalirungkut, Surabaya and the Groningen Research Institute of Pharmacy, Faculty of Science and Engineering, University of Groningen, The Netherlands. We would like to thank to Erik Christopher, Klinik Bahasa, Faculty Kedokteran, Universitas Gadjah Mada (Yogyakarta) for helping to edit the manuscript.

Declaration of competing interest

The authors declare that they have no conflict of interest.

Author contributions

FA was conceptualization and made the original draft the manuscript. The interviews were performed and the interview results were compared to document observation results by the authors SC, IA, SS, NL, NA, VA. HJW was writing, reviewing and editing. S, RY, EH, CA were reviewing and editing.

Ethics approval and consent to participate

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The written consent to participate were obtain from study participant. The study was approved by the respective hospital managements and was conducted in accordance with the Indonesian Law for the Protection of Personal Data. The study was ethically cleared by the Health Research Ethics Committee of Politeknik Kesehatan Kemenkes Surabaya, Kementerian Kesehatan No. 025/S/KEPK/V/2017.

Consent for publication

Interview participants received a participant information sheet and gave written consent.

Availability of data and materials

Not applicable.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Appendix 1. Questionnaire

General instruction

Please tick the boxes as clearly as possible with a blue or black pen. For every question, you can fill out one option unless stated otherwise.

A. General questions (question relating respondent of the questionnaire)		
1.	What is your gender?	<input type="checkbox"/> Man <input type="checkbox"/> Woman
2.	What is your age?	Years
3.	What is your position in this hospital?	<input type="checkbox"/> Director <input type="checkbox"/> Head of Committee Pharmacy Therapy <input type="checkbox"/> Vice Director <input type="checkbox"/> Other (please specify):
4.	How long have you worked in your current specialty or profession?	<input type="checkbox"/> < 1 year <input type="checkbox"/> 16 – 20 years <input type="checkbox"/> 1 – 5 years <input type="checkbox"/> 21 years or more <input type="checkbox"/> 6 – 10 years <input type="checkbox"/> 11 – 15 years

Definition:

Antibiotic stewardship refers to a coordinated interventions designed to improve the appropriate use of antibiotics by promoting the selection of the optimal antimicrobial drug regimen, dose, duration of therapy, and route of administration.

B. ORGANIZATIONAL STRUCTURE (question relating organizational structure in this hospitals)	
5.	Does your hospital have an antibiotic resistance controlling program?
	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
6.	How does your hospital maintain interdisciplinary communication?
	<input type="checkbox"/> Committees <input type="checkbox"/> Meetings <input type="checkbox"/> Monthly report <input type="checkbox"/> Others (specify):
7.	Who are part of this antibiotic resistance controlling program team in your hospital? (Please answer as your knowledge)
	PLEASE TICK IF AVAILABLE IN YOUR HOSPITALS <input type="checkbox"/> Clinical microbiologist <input type="checkbox"/> Clinical pharmacist <input type="checkbox"/> Management representative <input type="checkbox"/> Internist <input type="checkbox"/> Nurse <input type="checkbox"/> Ward/supervising physician <input type="checkbox"/> (prescribing) physician <input type="checkbox"/> Infection control representative
8.	Is there a physician leader that responsible for program outcomes of antibiotic stewardship activities at your hospitals?
	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
9.	Is there a clinical pharmacist responsible for working to improve antibiotic use at this hospital?
	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know

C. LEADERSHIP SUPPORT (question relating leadership commitment to implement antibiotic stewardship programs)		
10.	Does your hospital have a formal written statement of support from leadership that supports the implementation of antibiotic stewardship program?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
11.	Does your facility receive any budgeted financial support for infection control activities?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
12.	Does your facility receive any budgeted financial support for education and training to improve the quality of antibiotic prescription?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
13.	Does your facility receive any budgeted financial for information technology (IT) support to produce the most useful data for antibiotic resistance surveillance?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
14.	Does your stewardship provide enough education programs to clinicians and other relevant staff on improving the quality of antibiotic used?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
D. INTERNAL AND EXTERNAL ENVIRONMENT (question relating internal & external environment that promote the prudent use of antibiotic in this hospital)		
15.	Does your hospital have a policy that requires prescribers to document in the medical record or during entry; a dose, duration, and indication for all antibiotic prescriptions?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
16.	Does your hospital have a hospital-specific treatment recommendation (guideline), based on national guidelines and local susceptibility?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
17.	Please tick is this antibiotic stewardship strategy is available in your hospitals. (Multiple answers is possible)	<input type="checkbox"/> Formulary restriction <input type="checkbox"/> Pre-authorization. ^(a) <input type="checkbox"/> Audit and feedback <input type="checkbox"/> Antibiotic cycling. ^(b) <input type="checkbox"/> Antibiotic guideline. <input type="checkbox"/> Antibiotic order form. <input type="checkbox"/> Others
18.	Is there a standard procedural for all clinicians to review the appropriateness of all antibiotic prescription (audit and feedback)?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
19.	Does your hospital provide an access to literature or evidence based medicine for medical staff while delivering care?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know

Definition:

- a. Pre-authorization: a procedure that requires a prescriber to obtain permission to prescribe antibiotic prior to prescribing it. Also called prior approval.
- b. Antibiotic cycling: is the scheduled rotation of one class of antibiotics with one or more different classes exhibiting comparable spectra of activity.

E. INFORMATION (question relating information report on antibiotic use, prudent use of antibiotic, and resistance to doctors, nurses, relevant staff, and patients)		
20.	Does your hospital shared an information/report on the hospital current antibiotic consumption to prescribers?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
21.	Does your hospital shared an information/report on the hospital current prevalence of antibiotic resistance to prescribers?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
22.	Does your hospital distributed current antibiogram to prescribers?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
23.	Does your hospital distributed current antibiotic formularium to prescribers?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
24.	Does your hospital provide a sufficient information regarding the prudent use of antibiotic and resistance for patients? (Multiple answers possible)	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know If YES , please specify the information you provide for patients. (Multiple answers are possible) <input type="checkbox"/> Poster <input type="checkbox"/> Leaflet <input type="checkbox"/> Internet <input type="checkbox"/> Others

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